2024 Field report – permit NRI 02 028 24R-M

Project title: Northern Ellesmere Island in the Global Environment (NEIGE)
ᐅᐊᖅᓇᖏᓂ ᐊᐅᓗᐃᑦᑐᐊ ᖁᑭᖅᑕᓪᖏᓂ ᓗᓪᓚᕐᐊᒥ ᐊᕐᑎᖏᓂ (NEIGE)

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Abstract: *A concise summary of what was done, found, and concluded to date, and how the results/information will be used. This summary must be translated into the appropriate dialect of Inuktut. Suggested length: 250-300 words. *This section will be published in the NRI's annual compendium of licensed research*

The NEIGE (Northern Ellesmere Island in the Global Environment) project focuses on the impact of climate change on high-Arctic lake ecosystems, specifically examining microbial communities and biogeochemical processes. In 2024, research was conducted across two main field campaigns.

In June, near Resolute Bay, the team sampled Meretta and Small Lakes, focusing on microbial communities and biogeochemical cycling. Samples were collected to analyse environmental viruses and other microbes, and physico-chemical analyses were also conducted.

In July, the team travelled to Ward Hunt Island where they maintained infrastructure, extracted data from existing sensors, and collected water samples from Ward Hunt Lake. This involved retrieving, cleaning, and redeploying the lake mooring, adding new sensors for organic matter and chlorophyll a, and servicing the SILA weather station. The team also downloaded data from the high-resolution automated camera. Preliminary results from Ward Hunt Lake showed the lowest dissolved oxygen spike in almost 10 years, with surface water temperatures slightly cooler than in previous years. Additionally, the team noted the

absence of lemmings and observed seals near Disraeli Fjord, a first observation of seals in the area to our knowledge.

Data collected will be used to understand how climate warming affects these fragile ecosystems and their microbial inhabitants. The long-term data sets will contribute to monitoring efforts in the region and will help to inform policy decisions related to the conservation of high-Arctic aquatic systems. The research also explores the role of meltwater in transporting terrestrial microbes and nutrients and tracks the vertical distribution of key redox-active species. Furthermore, the project examines genomic adaptations allowing microbes to endure the harsh conditions of lake ice.

NEIGE (ᐅᐊᓐᓇᖓᓂ ᐊᐅᓯᐃᑦᑑᑉ ᕿᑭᖅᑖᓗᖓᓂ ᓯᓚᕐᔪᐊᒥ ᐊᕙᑎᖓᓂ) ᐱᓕᕆᐊᖅ ᐱᓕᕆᐊᓪᓗᐊᑕᕐᑲᖅᑐᖅ ᐊᑦᑐᖅᑕᐅᔪᓂᑦ ᓯᓚᖓᓄ ᐊᓯᔾᔨᕐᓂᖓᓄᑦ ᖁᑦᑎᑦᑐᒥ ᐅᑭᐅᑕᖅᑐᒥ ᑕᓯᖏᓐᓂ ᐊᕙᑎᖏᓐᓂ, ᖃᐅᔨᓴᕐᓂᖃᓗᐊᖅᑐᑦ ᒥᑭᔫᑎᕋᓖᓂᑦ ᐆᒪᔪᓂᑦ ᐊᒻᒪ biogeochemical ᐱᕙᓪᓕᐊᓂᖏᑦ. 2024–ᒥ, ᖃᐅᔨᓴᕐᓂᖃᓚᐅᖅᑐᑦ ᒫᕿᓐᓂᒃ ᖃᐅᔨᓴᕐᕕᒋᔭᓪᓗᐊᑕᐅᔫᓐᓂᒃ.

ᔫᓂᒥᑦ, ᖃᓂᒋᔭᖓᓂ ᖃᐅᓯᐃᑦᑐᖅ, ᐱᓕᕆᔾᔨᑦ ᖃᐅᔨᓴᕐᕕᒋᓚᐅᖅᑕᖏᑦ Meretta ᐊᒻᒪ ᒥᑭᔪᑦ ᑕᓲᑦ, ᐱᔾᔪᑎᖃᓗᐊᖅᑐᑎᑦ ᒥᑭᔫᑎᕋᓖᓂᑦ ᐆᒪᔪᓂᑦ ᐊᒻᒪ biogeochemical ᐅᑎᖅᑕᖃᑦᑕᕐᓂᖏᑦ. ᖃᐅᔨᓴᕋᓴᐃᑦ ᓄᐊᑕᐅᓚᐅᖅᑐᑦ ᖃᐅᓕᓴᖅᑕᐅᓗᑎ ᐊᕙᑎᖓᓂ ᐋᓐᓂᐊᓇᖅᑐᓂᑦ ᐊᒻᒪ ᐊᓯᖏᓐᓂ ᒥᑭᔫᑎᓂᑦ ᐆᒪᔪᓂᑦ ᐊᒻᒪ ᐃᓗᓕᖏᓐᓂ ᖃᐅᔨᓴᐃᓂᐅᔪᓄᑦ ᐱᓕᕆᔭᐅᓚᐅᕐᒥᔪᑦ.

ᔪᓚᐃᒥ, ᐱᓕᕆᔾᔨᑦ ᐅᑭᐊᓪᓕᕕᒻᒨᓚᐅᖅᑐᑦ ᒪᑭᑕᑎᑦᑎᕕᒋᔭᖓ ᐱᕐᑯᑎᕐᔪᐊᓂᑦ, ᐲᖅᓯᓚᐸᐅᖅᑐᑦ ᑐᑭᓯᒋᐊᕈᑎᓂᑦ ᒫᓐᓇᐅᔪᒥᑦ ᖃᐅᔨᓴᐅᑎᓂᑦ, ᐊᒻᒪ ᓄᐊᑦᑎᓚᐅᖅᑐᑦ ᐃᒥᕐᓂ ᖃᐅᔨᓴᕋᕐᓴᓂᑦ ᐅᑭᐊᓪᓕᕕᒻᒥ ᑕᓯᖓᓂ. ᑖᓐᓇ ᐱᕐᑲᓯᐅᔾᔨᓚᐅᖅᑐᖅ ᐱᔭᐅᓂᖏᓐᓄᑦ, ᓴᓗᒪᓴᖅᑕᐅᓂᖏᓐᓄᑦ, ᐊᒻᒪ ᐋᖅᑭᑕᐅᒃᑲᓂᕐᓂᖏᓐᓄᑦ ᑕᓯᕐᒥᑦ ᑭᓴᖅᓯᒪᔪᑦ,

ᐃᓚᓯᓪᓗᑎ ᓄᑖᓂᑦ ᖃᐅᔨᓴᐅᑎᓂᑦ ᐱᕈᖅᑐᕐᑲᓂᕐᒧᑦ ᐊᒻᒪ chlorophyll a, ᐊᒻᒪ ᐱᔾᔦᑎᖅᑐᒋᑦ SILA ᓯᓚᖓᓄᑦ ᖃᐅᔨᓴᕐᕕᒃ. ᐱᓕᕆᔾᔨᑦ ᖃᕋᓴᐅᔮᖅᓯᓚᐅᕐᒥᐅᔪᑦ ᑐᑭᓯᒋᐊᕈᑎᓂᑦ ᐊᔾᔨᙳᐊᑦᑎᐊᕙᓐᓂᑦ ᐊᔾᔨᓕᐅᕆᑦᑕᐅᑎᒋᔭᖅᑐᓂᑦ ᐊᔾᔨᓕᐅᕈᑎᓂᑦ. ᖃᓄᐃᓐᓂᕆᒋᐊᓐᖓᖅᑕᖏᑦ ᐅᑭᐊᓪᓕᕕᒻᒥ ᑕᑯᓴᐅᑎᑦᑎᓚᐅᖅᑐᑦ ᓄᖑᑎᖅᓯᒪᔪᑦ ᐊᓂᕐᓂᖃᓇᖅᑐᑦ ᖃᓂᒋᔭᖏᓐᓂᐅᓕᖅᑐᖅ 10 ᐊᕐᕋᒎᐃᑦ, ᐃᒪᐅᑉ ᖄᖓ ᐅᓇᕐᓂᖓ ᓂᓪᓕᓇᕐᓂᖅᓴᐅᕋᔾᔪᑦᑐᓂ ᓴᓂᐊᓂ ᐊᕐᕋᒍᕐᑲᑦᑕᖅᓯᒪᔪᓂᑦ. ᐃᓚᒋᐊᕐᓗᒍ, ᐱᓕᕆᔾᔨᑦ ᓇᓗᓇᐃᖅᓯᓚᐅᖅᑐᑦ ᐱᑕᕐᑲᖏᓐᓂᖏᑦ ᐊᕕᙳᐊᑦ ᐊᒻᒪ ᑕᑯᔭᐅᕐᑲᑦᑕᖅᓯᒪᔪᑦ ᓇᑦᑏᑦ ᖃᓂᒋᔭᖓᓂ Disraeli Fjord, ᓯᕗᓪᓕᖅᐹᒥ ᑕᑯᔭᐅᔪᑦ ᓇᑦᑏᑦ ᓇᒦᓐᓂᖓᓂ ᐅᕙᒍᑦ ᖃᐅᔨᒪᔭᖏᓐᓇ.

ᑐᑭᓯᒋᐊᕈᑏᑦ ᓄᐊᑕᐅᓚᐅᖅᑐᑦ ᐊᑐᖅᑕᐅᓂᐊᖅᑐᑦ ᑐᑭᓯᔾᔪᑎᒋᓗᒋᑦ ᖃᓄᑦ ᓯᓚᖓ ᐅᖅᑰᓯᕙᓪᓕᐊᓂᖓᓄᑦ ᐊᑦᑐᐃᓂᕐᑲᕐᒪᖔᑕ ᑖᒃᑯᓂᖓ ᐊᑦᑐᖅᑕᐅᓴᕋᐃᑦᑐᓂ ᐊᕙᑎᖏᓐᓂ ᐊᒻᒪ ᒥᑭᔫᑎᕋᓖᓄᑦ ᐆᒪᔪᓄᑦ ᓇᔪᕐᑲᑦᑕᖅᑕᖏᑦ. ᐊᑯᓂᐅᔪᒧᑦ ᑐᑭᓯᒋᐊᕈᑏᑦ ᓄᐊᑕᐅᓯᒪᔪᑦ ᐃᑲᔪᕈᑎᕐᑲᓂᐊᖅᑐᑦ ᖃᐅᔨᓴᕐᑲᑦᑕᓂᕐᒧᑦ ᐊᕕᑦᑐᖅᓯᒪᔪᒥᑦ ᐊᒻᒪ ᐃᑲᔪᕐᓂᐊᖅᑐᑎ ᖃᐅᔨᑎᑦᑎᔪᑎᐅᓗᑎ ᐊᑐᐊᒐᕐᒥ ᐃᓯᒪᓕᐅᕐᓂᐅᔪᓄᑦ ᐊᑦᑐᐊᓂᓕᓐᓄᑦ ᓴᐳᒻᒥᑦᑎᓂᕐᒧᑦ ᖁᑦᑎᑦᑐᒥ ᐅᑭᐅᑕᖅᑐᒥ ᐃᒪᕐᓄᑦ ᐊᑐᖅᑕᐅᔪᓂᑦ. ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᕿᓂᕐᓂᐊᕐᒥᔪᖅ ᖃᓄᐃᓘᕐᓂᕆᔭᖓ ᐊᐅᔾᓯᒪᔪᑦ ᐃᒥᑦ ᓄᓇᒃᑰᖅᑐᑦ ᒥᑭᔪᕋᓛᑦ ᐆᒪᔪᐃᑦ ᐊᒻᒪ ᐆᒪᔫᓇᐅᑎᓂᑦ ᐊᒻᒪ ᖃᐅᔨᒪᓪᓗᒋᑦ ᖁᒻᒧᑦ ᐊᒻᒪᑦ ᓇᒧᖓᕐᑲᑦᑕᕐᓂᖏᑦ ᓇᓗᓇᐃᖅᓯᒪᔪᓂᑦ redox-active ᐆᒪᔪᓂᑦ. ᐃᓚᒋᒋᐊᕐᓗᒍ, ᐱᓕᕆᐊᖅ ᖃᐅᔨᓴᕐᓂᕐᑲᖅᑐᖅ ᒥᑭᔪᓂᑦ ᐆᒪᔪᓂᑦ ᐊᑐᓕᕈᓐᓇᕐᓂᖏᓐᓄᑦ ᒥᑭᔫᑎᕋᓖᑦ ᐆᒪᔪᐃᑦ ᐱᒡᒐᓇᖅᑐᒥᑦ ᑕᓯᐅᑉ ᓯᑭᖓᓂ.

Key messages: *Concise, plain language summary of key take-away messages of work to date, findings and conclusions. Preferably 3-5 points, in bullet form.*

Key takeaways from the 2024 NEIGE project field work include:

- High-Arctic lake ecosystems are highly sensitive to changes in ice cover, which impacts water temperature and dissolved oxygen levels. Data from Ward Hunt Lake showed the lowest dissolved oxygen spike in almost 10 years and slightly cooler surface water temperatures in 2024 compared to previous years.
- Meltwaters carry terrestrial microbes and nutrients into lakes, but these terrestrial-originating microbes do not survive in the lake environment. This suggests that further warming and increased meltwater could lead to a loss of microbial diversity in these ecosystems.
- Microbes in lake ice have unique genomic adaptations that allow them to endure harsh conditions. Research on ice cores revealed these adaptations, highlighting the importance of ice as a habitat for microbial life.
- The project maintains long-term time-series of environmental conditions in the High Arctic. This includes automated measurements of lake temperature, dissolved oxygen and light, as well as weather data and images of ice cover. This data is available to stakeholders via open-access online database.

Unusual wildlife observations were made on Ward Hunt Island, including the absence of lemmings, signs of weasel activity, and the first observation of seals near the coast.

ᑐᓴᖅᑎᑦᑎᒍᑎᓪᓗᐊᑕᐅᔪᑦ 2024 NEIGE ᐱᓕᕆᐊᒥᑦ ᖃᐅᔨᓴᕐᕕᐅᔪᒥᑦ ᐱᖃᓯᐅᔾᔨᔪᑦ:

- ᖁᑦᑎᑦᑐᒥ ᐅᑭᐅᑕᖅᑐᒥ ᑕᓲᑦ ᐊᕙᑎᖏᑦ ᐊᑦᑐᖅᑕᐅᓯᕐᑲᐃᑦᑐᖅ ᐊᓯᔾᔨᖅᑐᓄᑦ ᓯᑯᖃᕐᓂᖓᓄᑦ, ᐊᑦᑐᐃᓂᖃᖅᑎᑦᑎᔪᑦ ᐃᒪᖓᓂ ᐆᓇᕐᓂᖓᓂ ᐊᒻᒪ ᓄᖑᑎᖅᓯᒪᔪᑦ ᐊᓂᕐᓂᖃᕐᓇᐅᑏᑦ ᖁᕚᕙᓯᓐᓂᖏᑦ. ᑐᑭᓯᒋᐊᕈᑏᑦ ᐅᑭᐊᓪᓕᕖᒥ ᑕᓯᖓᓂ ᑕᑯᔅᓴᐅᑎᑦᑎᓚᐅᖅᑐᑦ ᐊᑦᑎᓛᖑᓯᒪᔪᑦ ᓄᖑᑎᖅᓯᒪᔪᑦ ᐊᓂᕐᓂᖃᕐᓇᐅᑏᑦ ᖃᓂᒋᔭᖏᓐᓂ 10 ᐊᕐᕌᒍᓂᑦ ᐊᒻᒪ ᓂᓪᓕᓇᕐᓂᖅᓴᐅᕌᔾᔪᑦᑐᓂ ᐃᒪᐅᑉ ᖄᖓ ᐆᓇᕐᓂᖓ 2024–ᒥ ᐊᔾᔨᒋᑎᙳᐊᖅᑐᒍ ᐊᕐᕌᒎᖃᑦᑕᖅᓯᒪᔪᓂᑦ.
- ᐊᐅᔭᒪᔪᓂᑦ ᐃᒦᑦ ᐃᓗᓕᖅᑲᖃᑦᑕᖅᑐᑦ ᓄᓇᒃᑯᑦ ᒥᑭᔫᑎᕋᓛᓂᑦ ᐆᒪᔪᓂᑦ ᐊᒻᒪ ᐆᒪᔾᔭᓇᐅᑎᓂᑦ ᑕᓯᐅᑉ ᐊᕙᑎᖓᓂ, ᑭᓯᐊᓂ ᑖᒃᑯᐊ ᓄᓇᒦᖔᖅᓯᒪᔪᑦ ᒥᑭᔫᑎᕋᓛᑦ ᐆᒪᔪᐃᑦ ᐆᒪᔾᔭᓇᖏᑦᑐᑦ ᑕᓯᐅᑉ ᐊᕙᑎᖓᓂ. ᑖᓐᓇ ᓇᓗᓇᐃᖅᓯᔪᖅ ᐅᖅᑰᓯᕙᓪᓕᐊᓂᖓ ᐊᒻᒪ ᐊᐅᔭᒪᔪᑦ ᐃᒥᑦ ᐱᑕᖃᕈᓐᓃᑎᑦᑎᔾᔪᓇᖅᑐᑦ ᒥᑭᔪᕋᓛᓂᑦ ᐆᒪᔪᓂᑦ ᑖᒃᑯᓇᓂ ᐊᕙᑎᖏᓐᓂ.
- ᒥᑭᔫᑎᕋᓛᑦ ᐆᒪᔪᐃᑦ ᑕᓯᐅᑉ ᓯᑯᖓᓂ ᐊᔾᔨᐅᖏᑦᑐᒥ ᐊᑐᓕᕈᓐᓇᖅᑐᑦ ᐱᕐᕚᓇᖅᑐᒥᑦ ᐆᒪᔾᔭᓇᖅᑐᑎᑦ ᖃᓄᐃᓐᓂᕆᔭᖏᓐᓂ. ᖃᐅᔨᓴᕐᓂᐅᔪᑦ ᓯᑯᖓᓂ ᐴᖅᑕᐅᓯᒪᔪᓂᑦ ᓴᖅᑭᑎᑦᑎᓚᐅᖅᑐᑦ ᑖᒃᑯᓂᖓ ᐊᑐᓕᕈᓐᓇᕐᓂᐅᔪᓂᑦ, ᑕᑯᔅᓴᐅᑎᑦᑎᓂᖅᖢᑎᑦ ᐱᒻᒪᕆᐅᓂᖓᓄ ᓯᑯᖓ ᓇᔪᕕᐅᕙᑦᑐᓂ ᒥᑭᔫᑎᕋᓛᓄᑦ ᐆᒪᔪᓄᑦ.
- ᐱᓕᕆᐊᖅ ᐱᓯᒪᑦᑎᔪᖅ ᐊᑯᓂᐅᔪᒧᑦ ᖃᖓᒃᑰᓂᖏᓐᓄᑦ ᐊᕙᑎᖓᓂ ᖃᓄᐃᓐᓂᕆᔭᖏᓐᓂ ᖁᑦᑎᑦᑐᒥ ᐅᑭᐅᑕᖅᑐᒥ. ᑖᓐᓇ ᐱᖃᓯᐅᔾᔨᔪᖅ ᖃᐅᔨᓴᑦᑕᐅᑎᒋᔭᖅᑐᑦ ᑕᓯᖓᓂ ᐆᓇᕐᓂᖓᓂ, ᓄᖑᑎᖅᓯᒪᔪᓂᑦ ᐊᓂᕐᓂᖃᕈᑎᓂᑦ ᐊᒻᒪ ᖃᐅᔨᒪᓂᖓᓄᑦ, ᐊᒻᒪᓗᑦᑕᐅᖅ ᓯᓚᖓᓄᑦ ᑐᑭᓯᒋᐊᕈᑏᑦ ᐊᒻᒪ ᐊᔾᔨᙳᐊᑦ ᓯᑯᖓᓂ. ᑖᒃᑯᐊ ᑐᑭᓯᒋᐊᕈᑏᑦ ᐊᑐᐃᓐᓇᐅᔪᑦ ᑎᒍᒥᐊᖅᑎᐅᖃᑕᐅᔪᓄᑦ ᒪᑐᐃᖓᔫᒃᑯᑦ ᐃᕐᖏᓐᓈᕈᑎᒃᑯᑦ ᑐᑭᓯᒋᐊᕈᑎᓂᑦ.

ᐊᔾᔨᐅᖏᑦᑐᑦ ᐆᒪᔪᐃᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ ᐅᑭᐊᓪᓕᕖᒥ, ᐱᖃᓯᐅᑎᓪᓗᑎ ᐱᑕᖃᖏᓐᓂᖏᑦ ᐊᕖᙵᐃᑦ, ᑎᕆᐊᖅᑕᖃᑦᑕᖅᓯᒪᓪᓗᓂ, ᐊᒻᒪ ᓯᕗᓪᓕᖅᐹᒥ ᑕᑯᔭᐅᔪᑦ ᓇᑦᑏᑦ ᖃᓂᒋᔮᓂ ᐃᒪᖓᓂ.

Objectives: *Project objectives, preferably in bullet form.*

The overarching objective of the NEIGE project is to understand the impact of climate change on high-Arctic Lake ecosystems by monitoring environmental conditions, studying microbial communities, and analysing biogeochemical processes. Its specific objectives are:

- To determine the diversity of microbial life in shallow water communities, utilising state-of-the-art molecular techniques and define the structure and function of microbial food webs within specific lakes, including Lake A, C1, Ward Hunt, Disraeli Fjord and Milne Fjord.
- To characterise the physical characteristics and processes within northern Ellesmere Island's meromictic lakes
- To use climate stations to provide long-term air and soil monitoring data for the globally important site and thus understand the biogeochemical response of high-Arctic lakes experiencing loss of ice. Specifically, to track the temporal changes in dissolved oxygen, photosynthetically active radiation, and temperature.
- To understand under-ice microbial dynamics and lake biogeochemistry by sampling lakes on Cornwallis Island, specifically Resolute, Meretta, Small and North lakes5 and perform taxonomic and functional identification of the microbes in these lakes' ice cover, water column and sediments.
- To measure the contribution of sediments to major, trace and nutrients to track their cycling in the lakes on Cornwallis Island.

To use the distribution of elements sensitive to dissolved oxygen to track the effects of low oxygen as ice cover decreases with climate warming and better understand the biogeochemical processes underway in lakes during the late Spring, when limited light penetrates the ice cover.

Annual activities: *A description of activities and methods carried out during the current reporting period. This section should answer the questions: What? Where? When? Who? How? Include dates team members conducted research at remote field sites or collected data (including interviews) in communities; append a map with locations and/or coordinates of remote field sites, if applicable.*

See Appendix 1. Annual activities & Results

Results and Achievements: *Findings and results to date of the above activities, highlighting any key research achievements (see guide below for formatting tips regarding tables and figures).*

See Appendix 1. Annual activities & Results

Challenges/Obstacles: *In this section, please comment on any challenges/obstacles (if any) that you experienced during this project year. If there were any actions to mitigate or resolve these challenges, please list them here. Were any concerns raised regarding the conduct of research team members or the impacts of the project?*

Continuity of monitoring requires ongoing financial resources and PCSP support, given the high cost of polar research. The pandemic is still affecting all aspects of the implementation of the project including the availability and cost of supplies, mentoring, networking, HQP recruitment, collaboration, access to facilities, and access to our northern research sites. An additional challenge is the impact of increasingly unstable weather on Ellesmere Island on logistics operations, including increased no-fly days, unstable landing strips, and thinner lake ice. To mitigate this, we worked on improving the landing strip at Ward Hunt Island this year, to ease future Twin Otter operations on the Island and maintained our efforts to secure funding

to maintain our operations. Furthermore, we are continuing our work with our Northern collaborators.

Expected Project Completion Date: *Provide month and year of expected completion date of the project.*

August 2030

Project website (if applicable): *If your project has a presence on the internet, including a website and/or social media page, please provide the link and/or account handle.*

n/a

POLICY RELEVANCE

Does this research support policy development or decision-making in Nunavut? If yes, please describe.

The research conducted as part of the NEIGE project directly supports policy development and decision-making in Nunavut. The project's findings are relevant to the conservation of high-Arctic aquatic systems and the management of resources, and the data is intended to be accessible to all stakeholders including northern communities.

Specifically:

- **Time-series of climate change impact in lakes: The project generates time-series documenting** environmental changes in the High Arctic, including the effects of warming on ice cover, water temperature, and dissolved oxygen. This data is pivotal for understanding the rate and extent of climate change impacts on these sensitive ecosystems and can be used to inform policy decisions related to climate change mitigation and adaptation. By focussing on lakes as sensitive indicators of global change, this project can serve as an early warning system for broader environmental changes in the Arctic.
- **Understanding microbial ecosystems:** Research on microbial communities in lakes provides insights into the base of the food web in these systems. Changes in microbial communities can impact the availability of resources for other aquatic organisms, including fish species that are important for Inuit communities. This knowledge can inform policies related to the sustainable management of these resources – for instance by allowing limited managerial ressources to those lakes where fish habitats is better sustained by the food-web.
- **Assessing water quality:** By measuring parameters such as dissolved oxygen, pH, and trace elements levels, the project contributes to documenting overall water quality. This information is important for assessing potential threats to water quality, such as the introduction of pollutants.
- **Community engagement:** The project involves community consultation, and the results are shared with local communities. This ensures that the research is relevant to the concerns and priorities of local communities and also provides an avenue for the integration of local knowledge into the scientific research. Furthermore, This research aligns with the priorities of both NRI and Park Canada regarding the effective management of protected areas.

RESEARCH OUTCOMES: BENEFITS

Community engagement: *Briefly list and describe any community consultation, engagement, collaboration and outreach activities that you have undertaken for the project; describe the role(s) that community members and/or specific organizations have played in research co-design and activities*.

Our community engagement efforts are summarized as follows :

Community Consultation: The project involves ongoing consultations with communities. This includes meetings with residents of Resolute Bay and Grise Fjord at ArcticNet workshops and other events as well as consultations with the Resolute Bay Hunters and Trappers Organization (HTO). We rely on insights from the community regarding ice conditions, fish habitats, and fish mortality under ice. This local knowledge is related to the oxythermal and optical habitats studied in the project.

Local Collaboration: The project actively collaborates with Debbie Iqaluk from Resolute Bay. She is a long-time research partner who supports field operations and has extensive experience in scientific sampling. She is involved in all sampling activities. Additionally, the team meets with Resolute Bay collaborators who have previously joined them in the field.

Inuktitut Translation: To ensure that the research is accessible, the project funds Inuktitut translation of reports and summaries. •

Co-authorship: Whenever possible, Northern partners are invited to join the research team as co-authors in publications. This ensures that community members are acknowledged for their contributions to the research and demonstrates meaningful collaboration and knowledge sharing.

Outreach Activities: The research team is involved in outreach activities. We endeavor to visit schools in Resolute Bay to share our research and gather feedback. We have shared our work through presentations at ArcticNet Annual Science Meetings, held in Ottawa in December 2024. The meeting was well attended by Inuit community members.

Youth engagement: *Briefly list and describe any outreach, school or classroom activities that you have undertaken for the project; describe the role(s) that youth have played in your research activities*.

No youth engagement activities were held in 2024.

Training and Employment:

How many Nunavummiut received training from team members? Please describe training and/or compensation provided.

No Nunavummiut recieved training from team members in 2024.

How many team members received training from Nunavummiut? Please describe training received and/or what knowledge sharing and/or skills exchange took place.

In 2024, 6 team members recieved training from our Nunavummiuq colleague. This included knowledge sharing on safe traveling across the land, safe accessing of frozen lakes near Resolute Bay, as well as on the history of sampled lakes.

How many Nunavummiut received employment? Please describe employment type and length, role(s) and responsibilities, and compensation provided.

In 2024, one Nunavummiuq (Debbie Iqaluk) received employment during the Resolute Bay portion of our work. This person was employed June 17-20 at 500$/day, and acted as a guide, bear monitor and as a knowledge holder, contributing to sampling and to data interpretation on the field. Since the beggining of our project in 2017, three Nunavummiut have been employed, for the same responsibilities and salary as described above).

How many Nunavummiut received honoraria as research participants? Please describe method of participation (interview, observation, sample, survey, etc.), including compensation provided.

None

Please explain how the project directly benefited Nunavut organizations and/or businesses (e.g., through contract services, local purchases, equipment donations, etc.)

This project included the purchase of a snowmobile for our Nunavummiuq colleague, who we have been collaborating with for over 10 years and who is involved in many of our research projects.

The project funds the translation of research materials, including reports and summaries, into Inuktitut.

Academic Mobility

If you are affiliated with an academic institution, please answer the following question: For which Level of Project(s) will the data be used? (Check all that may apply)

X Research
X Post-Doctoral Research
X PhD Thesis
X Masters (Major Research Paper)
X Masters (Thesis)
Graduate Course Project
Staff/Administration Research
Undergraduate Honours Thesis

BUDGET

Please complete the table below to detail your projected and actual research expenditures during the reporting period.

The total estimated project cost for the 2024 fieldwork, as detailed in the budget, is $109,100, which includes items such as field equipment, meals, permits, travel and accommodation, and cargo freight.

Category	**Planned/Approved expenditure**	**Actual expenditure**
Travel and Accomodation	$60,000	$56,000
Equipment, Materials and Supplies	$30,000	$30,000

Salaries/Wages for Nunavut residents	$2,000	$2,000
Salaries/Wages for non-Nunavut residents	$12,000	$12,000
Professional Fees and services in Nunavut		
Professional Fees and services outside Nunavut	$9,000	$9,100
Total expenditures	$113,000	$109,100

List the total $ amount of funding from each funding source for your full research program, including in-kind support.

Grants and awards
NSERC Discovery and Northern Supplement to Girard : $24,050
New Frontiers grand to Girard : $35,000
NSERC Discovery and Northern Supplement to Couture : $24,050
NSTP travel awards to students: $6,000
Sentinel North : $20,000

PCSP in-kind support:
For Resolute Bay field work: $30,000
For Ward Hunt field work: $85,000

RESEARCH OUTPUTS / REPORTING TOOLS

What research outputs were generated? Please list below and append copies of each. Specify which outputs (if any) may be made public on the NRI research licensing database.

All our monitoring data are available on the public access database NordicanaD, to be linked to the NRI research licensing database:
Nordicana D79 / DOI : 10.5885/45678CE-5FCDB55196324288
Nordicana D1 / DOI : 10.5885/44985SL-8F203FD3ACCD4138
Nordicana D74 / DOI : 10.5885/45648CE-1A9AB63DFF91440B
Nordicana D133 / DOI : 10.5885/45906CE-35C5B5D9CBF54114
URLs for these data repositories are presented in Appendix 1. Activities and results

Have peer-reviewed manuscripts been published as a result of your project? If Yes, complete the following table:

Full citation	Publicly accessible/free to access (Y/N)	Link (if available) and DOI (if available)
Kochtitzky, W., Copland, L., Wohlleben, T., Iqaluk, P., Girard, C., Vincent, W. F., & Culley, A. I. (2022). Slow change since the Little Ice Age at a far northern glacier	Y	https://doi.org/10.1139/as-2022-0012

with the potential for system reorganization: Thores Glacier, northern Ellesmere Island, Canada. Arctic Science, 9(2), 451-464.		
Culley, A. I., Thaler, M., Kochtitzky, W., Iqaluk, P., Rapp, J. Z., Rautio, M., ... & Girard, C. (2022). The Thores Lake proglacial system: remnant stability in the rapidly changing Canadian High Arctic. *Arctic Science*, *9*(3), 720-733.	Y	https://doi.org/10.1139/as-2022-0023
Girard, C., Vincent, W. F., & Culley, A. I. (2023). Arctic bacterial diversity and connectivity in the coastal margin of the Last Ice Area. *ISME communications*, *3*(1), 105.	Y	https://doi.org/10.1038/s43705-023-00313-w
Provencher, J., George, P. B., Thaler, M., Vincent, W. F., Duchaine, C., Culley, A. I., & Girard, C. (2024). Microbial antibiotic resistance genes across an anthropogenic gradient in a Canadian High Arctic watershed. Sustainable Microbiology, 1(1), qvae021.	Y	https://doi.org/10.1093/sumbio/qvae021

The above publications are from previous years of our project. We expect to publish this year's results in peer-reviewed publications by late 2025-early 2026.

Were non-peer reviewed materials produced to either communicate or synthesize results to the public? Examples of these materials include (but are not limited to): websites, reports, brochures, podcasts, webinars, presentations, non-peer reviewed publications, etc. If Yes, complete the following table:

Title	Description of materials	Link (if available)	DOI (if available)
NEIGE 2022 Ward Hunt	Nordicana D79	https://nordicana.cen.ulaval.ca/dpage.aspx?doi=45678CE-5FCDB55196324288	10.5885/45678CE-5FCDB55196324288
CEN weather	Nordicana D1	https://nordicana.cen.ulaval.ca/dpage.aspx?doi=44985SL-8F203FD3ACCD4138	10.5885/44985SL-

stations			8F203FD3ACCD4138
NEIGE 2023 Ward Hunt	Nordicana D74	https://nordicana.cen.ulaval.ca/dpage.aspx?doi=45648CE-1A9AB63DFF91440B	10.5885/45648CE-1A9AB63DFF91440B
Ward Hunt limnology	Nordicana D133	https://nordicana.cen.ulaval.ca/dpage.aspx?doi=45906CE-35C5B5D9CBF54114	10.5885/45906CE-35C5B5D9CBF54114

Did your project develop a communications plan? Please describe communications/reporting tools used, and list the target audience for each and/or who requested which.

We do not have a targeted communications plan, but we are aiming to develop one in the upcoming year.

How were Nunavummiut credited and/or acknowledged in all project outputs, such as co-authorship, participant biographies, article acknowledgements, etc.

All Nunavummiut colleagues are credited in peer-reviewed publications, participant lists and in presentation (poster or oral) presentations. One of our colleagues (P. Iqaluk) is a co-author of two peer-reviewed publications (Kochtitzky et al. 2022 & Culley et al. 2023, cited above).

DATA AND INTELLECTUAL PROPERTY

Did you enter into a research agreement, data-sharing agreement and/or intellectual property rights agreement with a community and/or designated Inuit organization (DIO)? If yes, please explain.

No

Do intellectual property rights apply to your research? If yes, please explain.

No

Who owns the data? Has the raw data been shared with the appropriate community and/or DIO? If yes, how? How is data security and storage handled by community-based co-owners?

As agreed upon when presenting our project with community partners, with Parks Canada and the Nunavut Research Institute, all data are publicly available in online repositories including Nordicana D (DOIs listed above) as well as on the Sequence Read Archive (for microbial genomes).

Where is the data stored and will the data be destroyed within a set timeframe?

The project publishes environmental data in the Nordicana D open-access data report series. This series is available online, and it makes data accessible to all stakeholders, including northern communities. For example, data from Ward Hunt Lake is available in Nordicana D79 and Nordicana D133 hosted on servers at Université Laval. There is no plan or timeframe for data destruction.

Is the data trackable and/or available in a public data repository? If yes, please provide the appropriate information and/or link to ensure the findability and accessibility of the data.

The data from the NEIGE project is trackable and available in a public data repository. The project makes use of the Nordicana D open-access data report series as its primary means of disseminating environmental data. This series is designed to be accessible to all stakeholders, including northern communities, and is available online.

Specifically:

Ward Hunt Lake data: This includes a year-long record of lake temperatures, underwater light, and, more recently, organic matter and chlorophyll a. This data is available on the Nordicana D page for Ward Hunt Lake with the following DOI: 10.5885/45678CE-5FCDB55196324288. This data is also referenced in Nordicana D1332.

SILA weather station data: The data acquired by the SILA weather station on Ward Hunt Island, as well as images from the high-resolution automated camera that tracks changes in ice cover, is also available in the Nordicana D series. The DOI for the Ward Hunt Island SILA station is: 10.5885/44985SL-8F203FD3ACCD4138. The DOI for lake ice cover data is: 10.5885/45648CE-1A9AB63DFF91440B.

Thores Lake data: Environmental data collected from Thores Lake are made available through the Nordicana D series, with DOIs: 10.5885/45669CE-3078BA69AC9944CA and 10.5885/45801CE-647F4C260BD64AEC

CLIMATE CHANGE

Is your research about climate change (causes, impacts, mitigation, adaptation, etc.)? If yes, explain.

The NEIGE project is significantly focused on understanding the impacts of climate change on the High Arctic, particularly on lake ecosystems. The research addresses the consequences of rapid Arctic warming, which is occurring four times faster than the global average. This warming is causing a reduction in the extent and duration of ice cover on lakes, which is a central focus of the project. We use high-frequency data to track changes in dissolved oxygen, water temperature, and ice cover in lakes, observing that decreased ice cover leads to warmer water and potentially more oxygen, which can impact the microbial communities.

The project investigates how these changes affect microbial communities and the biogeochemical cycles within the lakes. We study how meltwater carries terrestrial materials into the lakes, perturbing primary production and the lake's metabolism. However, terrestrial microbes do not survive in the lake water, which suggests that further warming may lead to a loss of these organisms. We also study the genomic adaptations that allow microbes to survive in the harsh conditions of lake ice.

Finally, we reveal how the changes in lake conditions will affect fish habitats which are important to Inuit communities. The project collects a long-term, high-frequency data set which is necessary for understanding the processes and implications of climate warming, and contributes to international efforts to model the effects of climate change on lakes. We considers how the quality of resources, including fish and drinking water, could be impacted.

The project's findings are therefore directly relevant to policy development and decision-making in Nunavut in the context of climate change.

PHOTOGRAPHS

If possible, please provide high-resolution photos of licensed research activities that NRI may use in communication materials, organizational reporting, and other promotional purposes. The photographer and all recognizable people in each photo must sign the attached Photo and Video Release form. Please also complete the table below for each photo provided and submit to NRI along with all required NRI photo release forms. The photographer/owner will be credited in all uses of the photograph(s).

See Appendix 2. Photos